PATENT COOPERATION TREATY

From the INTERNATIONAL BUREAU

PCT

NOTIFICATION CONCERNING SUBMISSION OR TRANSMITTAL OF PRIORITY DOCUMENT

(PCT Administrative Instructions, Section 411)

To:

MISCHLEWSKI, Darryl
P.O. Box 1254
Camberwell, VIC 3124
AUSTRALIE

Date of mailing (day/month/year) 17 February 2000 (17.02.00)	
Applicant's or agent's file reference	**IMPORTANT NOTIFICATION**
International application No. PCT/AU99/01101	International filing date (day/month/year) 13 December 1999 (13.12.99)
International publication date (day/month/year) Not yet published	Priority date (day/month/year) 14 December 1998 (14.12.98)
Applicant FOOD & PACKAGING CENTRE MANAGEMENT LIMITED et al	

1. The applicant is hereby notified of the date of receipt (except where the letters "NR" appear in the right-hand column) by the International Bureau of the priority document(s) relating to the earlier application(s) indicated below. Unless otherwise indicated by an asterisk appearing next to a date of receipt, or by the letters "NR", in the right-hand column, the priority document concerned was submitted or transmitted to the International Bureau in compliance with Rule 17.1(a) or (b).

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Priority date	Priority application No.	Country or regional Office or PCT receiving Office	Date of receipt of priority document
14 Dece 1998 (14.12.98)	PP 7696	AU	08 Febr 2000 (08.02.00)
14 Dece 1998 (14.12.98)	PP 7697	AU	08 Febr 2000 (08.02.00)
14 Dece 1998 (14.12.98)	PP 7702	AU	08 Febr 2000 (08.02.00)
27 July 1999 (27.07.99)	PQ 1847	AU	08 Febr 2000 (08.02.00)

The International Bureau of WIPO
34, chemin des Colombettes
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Authorized officer

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From the INTERNATIONAL BUREAU

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17 February 2000 (17.02.00)	
Applicant's or agent's file reference	**International application No.**
	PCT/AU99/01101

The applicant is hereby notified that the International Bureau has received the record copy of the international application as detailed below.

Name(s) of the applicant(s) and State(s) for which they are applicants:

FOOD & PACKAGING CENTRE MANAGEMENT LIMITED (for all designated States except US)
YU, Long et al (for US)

International filing date	:	13 December 1999 (13.12.99)
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Date of receipt of the record copy by the International Bureau	:	08 February 2000 (08.02.00)
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PATENT COOPERATION TREATY

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INTERNATIONAL PRELIMINARY EXAMINATION REPORT

(PCT Article 36 and Rule 70)

Applicant's or agent's file reference Starch PVOH	**FOR FURTHER ACTION**	See Notification of Transmittal of International Preliminary Examination Report (Form PCT/IPEA/416).
International application No. **PCT/AU99/01101**	International filing date *(day/month/year)* 13 December 1999	Priority Date *(day/month/year)* 14 December 1998
International Patent Classification (IPC) or national classification and IPC **Int. Cl.** [7] C08L 3/02, 3/06, 3/08; C08K 5/04, 5/09		
Applicant FOOD & PACKAGING CENTRE MANAGEMENT LIMITED et al		

1. This international preliminary examination report has been prepared by this International Preliminary Examining Authority and is transmitted to the applicant according to Article 36.

2. This REPORT consists of a total of 3 sheets, including this cover sheet.

   ☐ This report is also accompanied by ANNEXES, i.e., sheets of the description, claims and/or drawings which have been amended and are the basis for this report and/or sheets containing rectifications made before this Authority (see Rule 70.16 and Section 607 of the Administrative Instructions under the PCT).

   These annexes consist of a total of sheet(s).

3. This report contains indications relating to the following items:

I	☒	Basis of the report
II	☐	Priority
III	☐	Non-establishment of opinion with regard to novelty, inventive step and industrial applicability
IV	☐	Lack of unity of invention
V	☒	Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement
VI	☐	Certain documents cited
VII	☐	Certain defects in the international application
VIII	☐	Certain observations on the international application

Date of submission of the demand 6 July 2000	Date of completion of the report 1 November 2000
Name and mailing address of the IPEA/AU AUSTRALIAN PATENT OFFICE PO BOX 200, WODEN ACT 2606, AUSTRALIA E-mail address: pct@ipaustralia.gov.au Facsimile No. (02) 6285 3929	Authorized Officer **DR. A. TESSEMA** Telephone No. (02) 6283 2271

INTERNATIONAL PRELIMINARY EXAMINATION REPORT

International application No.
[redacted]T/AU99/01101

I. Basis of the report

1. With regard to the **elements** of the international application:*

[X] the international application as originally filed.

[ ] the description, pages , as originally filed,
pages , filed with the demand,
pages , received on with the letter of

[ ] the claims, pages , as originally filed,
pages , as amended (together with any statement) under Article 19,
pages , filed with the demand,
pages , received on with the letter of

[ ] the drawings, pages , as originally filed,
pages , filed with the demand,
pages , received on with the letter of

[ ] the sequence listing part of the description:
pages , as originally filed
pages , filed with the demand
pages , received on with the letter of

2. With regard to the **language**, all the elements marked above were available or furnished to this Authority in the language in which the international application was filed, unless otherwise indicated under this item.
These elements were available or furnished to this Authority in the following language which is:

[ ] the language of a translation furnished for the purposes of international search (under Rule 23.1(b)).

[ ] the language of publication of the international application (under Rule 48.3(b)).

[ ] the language of the translation furnished for the purposes of international preliminary examination (under Rules 55.2 and/or 55.3).

3. With regard to any **nucleotide and/or amino acid sequence** disclosed in the international application, was on the basis of the sequence listing:

[ ] contained in the international application in written form.

[ ] filed together with the international application in computer readable form.

[ ] furnished subsequently to this Authority in written form.

[ ] furnished subsequently to this Authority in computer readable form.

[ ] The statement that the subsequently furnished written sequence listing does not go beyond the disclosure in the international application as filed has been furnished.

[ ] The statement that the information recorded in computer readable form is identical to the written sequence listing has been furnished

4. [ ] The amendments have resulted in the cancellation of:

[ ] the description, pages

[ ] the claims, Nos.

[ ] the drawings, sheets/fig.

5. [ ] This report has been established as if (some of) the amendments had not been made, since they have been considered to go beyond the disclosure as filed, as indicated in the Supplemental Box (Rule 70.2(c)).**

* *Replacement sheets which have been furnished to the receiving Office in response to an invitation under Article 14 are referred to in this report as "originally filed" and are not annexed to this report since they do not contain amendments (Rules 70.16 and 70.17).*

** *Any replacement sheet containing such amendments must be referred to under item 1 and annexed to this report*

V. Reasoned statement under Article 35(2) with regard to novelty, inventive step or industrial applicability; citations and explanations supporting such statement

1. Statement

Novelty (N)	Claims	**2, 10**	**YES**
	Claims	**1, 3-9**	**NO**
Inventive step (IS)	Claims	**2, 10**	**YES**
	Claims	**1, 3-9**	**NO**
Industrial applicability (IA)	Claims	**1-10**	**YES**
	Claims		**NO**

2. Citations and explanations (Rule 70.7)

NOVELTY; INVENTIVE STEP: Claims 1, 3-9

(a) JP 8-325447 (b) JP 8-245836

The invention defined in claims 1 and 3-9 is fully disclosed by each of documents (a) and (b) above. Each document discloses a biodegradable composition comprising a modified starch, a water soluble polymer, such as ethylene vinyl alcohol copolymer and ethylene vinyl acetate copolymer, and a fatty acid (fatty acid amide) in amounts that fall within the ranges defined in the above claims (see abstracts). Therefore, present claims 1 and 3-9 do not satisfy the PCT requirements of novelty and inventive step.

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INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

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With international search report.

(54) Title: BIODEGRADABLE POLYMER

(57) Abstract

A biodegradable polymer is disclosed having the composition g) from 8 to 80 % by weight of a starch modified to include an hydroxyalkyl C_{2-6} group or modified by reaction with an anhydride of a dicarboxylic acid, preferably hydroxypropylated high amylose starch, a) from 0 to 87.9 % of starch, b) from 4 to 11 % by weight of a water soluble polymer selected from polyvinylacetate, polyvinyl alcohol and copolymers of ehtylene and vinylalcohol which have a melting point compatible with the molten state of the starch components, c) from 0 to 20 % by weight of a polyol plasticiser, preferably glycerol, d) from 0.1 to 1.5 % by weight of a C_{12-22} fatty acid or salt, preferably stearic acid and, e) 0 to 12 % added water. The polymers are suitable as biodegradable rigid sheet or flexible film materials for use in packaging foodstuffs.

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Biodegradable Polymer

This invention relates to improvements in biodegradable polymeric products particularly starch based polymers.

Background to the invention

There is an increasing demand for many plastic products used in packaging to be biodegradable. Trays in biscuit and chocolate packages are one example.

Starch films have been proposed as biodegradable alternatives for some time. USA patent 3949145 proposed a starch/polyvinyl alcohol/glycerol composition for use as a biodegradable agricultural mulch sheet.

Difficulties have been encountered in producing starch based polymers particularly by hot melt extrusion. The molecular structure of the starch is adversely affected by the shear stresses and temperature conditions needed to plasticise the starch and pass it through the extrusion die. For most products foaming has to be avoided and this generally requires attention because of the water content of the starch. Foaming has been avoided by degassing the melt prior to exiting the die as suggested in USA patents 5314754 and 5316578. The latter patent also avoids adding water to the starch. As explained in USA patent 5569692 by not drying starch and avoiding the addition of water the starch can be processed at temperatures between 120°C and 170 °C because the water bound to the starch does not generate a vapour pressure such as to require high pressures.

Another approach to improving the melt processability of starch is to provide an additive as in USA patent 5362777 which reduces the melting point of the starch. The additive is selected from dimethyl sulfoxide, a selection of polyols and amino or amide compounds.

In order to produce starch polymers for particular applications they have been blended with a range of other polymers. Biodegradable blown films are disclosed in USA patent 5322866 which blends raw starch, polyvinyl alcohol and talc with glycerol and water. USA patent 5449708 discloses compositions of starch ethylene acrylic acid and a salt of stearic acid plus a glycerol based lubricant. Flexible and clear transparent sheets are disclosed in USA patent 5374304. These are composed of a high amylose starch and a glycerol plasticizer. The use of starch in

conjunction with high amylose or modified starches has also been proposed. USA patents 5314754, and 5316578 both suggest the use of modified starches including hydroxypropyl substituted starches. Hydroxypropylation reportedly increases elongation at break and burst strength and improved resilience in the polymers. Although the efficacy of these special and modified starches is recognised, their cost inhibits the commercial acceptability of the products made from them.

It is an object of this invention to provide a biodegradable polymer which can be processed and thermoformed into sheet and shaped products without difficulty and have acceptable properties for its intended uses.

Brief Description of the Invention

To this end the present invention provides a process for forming biodegradable polymers which includes the steps of

a) forming a mixture of starch, a modified starch, a water soluble polymer or copolymer containing vinyl alcohol units, up to 20 % of added water or a polyol plasticizer and 0.4 to 1.5 % by weight of a C_{12-22} fatty acid or salt,
b) working the mixture and forming a melt within the temperature range of 130°C to 160 °C
c) reducing the temperature and further working the mixture and the extruding the mixture or injecting the mixture into a mould at a temperature of 85 °C to 105 °C without the need to remove water.

The process as defined allows starch based mixtures to be extruded without foaming. The need to vent the extruder to remove water prior to the mix exiting the extrusion die is not needed. Both rigid sheet and flexible starch based films can be made using this process. The foaming temperature of the mix is raised above the temperature at which the melt is most easily plasticised and extruded.

In another aspect, the present invention provides a biodegradable polymer having the composition

a) from 8 to 80% by weight of a starch modified to include an hydroxyalkyl C_{2-6} group or modfified by reaction with an anhydride of a dicarboxylic acid
b) from 0 to 87.9% of starch
c) from 4 to 11% by weight of a water soluble polymer selected from polyvinylacetate, polyvinyl alcohol and copolymers of ethylene and vinylalcohol which have a melting point compatible with the molten state of the starch components
d) from 0 to 20% by weight of a polyol plasticiser
e) from 0.1 to 1.5 % by weight of a C_{12-22} fatty acid or salt and
f) from 0 to 12 % by weight of added water.

The compositions defined include formulations suitable for forming films or thermoforming rigid products such as packaging trays. The defined compositions are easier to process as they can be extruded in film or sheet form without foaming. The extruded sheet can be thermoformed into shaped trays or containers for use as biodegradable packaging. Usually the need to vent the extruder to remove water prior to the mix exiting the extrusion die is not needed with these formulations.

The upper limit to the content of the modified starch is determined by its cost. This component contributes structural benefits to the resulting material. A preferred component is hydroxypropylated amylose. Other substituents can be hydroxyethyl or hydroxybutyl to form hydroxyether substitutions, or anhydrides such as maleic phthalic or octenyl succinic anhydride can be used to produce ester derivatives. The degree of substitution[the average number of hydroxyl groups in a unit that are substituted] is preferably 0.05 to 2.The preferred starch is a high amylose maize starch. A preferred component is a hydroxypropylated high amylose starch A939 marketed by Goodman Fielder. A preferred concentration range to meet cost parameters for biscuit trays is 12 to 24 %.

The other starch component is any commercially available starch. This may be derived from wheat, maize, potato, rice, oat, arrowroot, and pea sources.

Generally the water content is about 10 to 15 %. A preferred concentration range for starch is 50 to 70.6%

The polymer component c) of the composition is preferably compatible with starch, water soluble, biodegradable and has a low melting point compatible with the processing temperatures for starch. Polyvinyl alcohol is the preferred polymer but polymers of ethylene-vinyl alcohol, ethylene vinyl acetate or blends with polyvinyl alcohol may be used. A preferred concentration range for sheet material is 7 to 9%.

The preferred plasticiser is glycerol although ethylene glycol and diethylene glycol are also suitable as is sorbitol. Cost and food contact are important issues in choosing the appropriate plasticizer. For low humidity environments such as biscuit packages it has been found that lower plasticizer content improves the toughness and long term resilience of the material. This is partly due to the properties of the starch ether component and the fact that at low humidity plasticizers such as glycerol tend to remove water from the starch polymer and make it more brittle. It is possible to process the formulation with no plasticizer and the rigid polymer formed is flexible and has good impact resistance at low humidity. When the plasticiser content is low additional water is added to improve processing. Thus the plasticizer content is preferably 0 to 12% and the water content is 12 to 0%. For film processing the plasticizer content is preferably higher than for rigid sheet products.Higher concentrations of plasticiser improve flexibility and for flexible packaging films or mulch films the preferred plasticiser content is 10 to 16%.

The fatty acid or fatty acid salt component is preferably present in concentrations of 0.6 to 1%. Stearic acid is the preferred component. Sodium and potassium salts of stearic acid can also be used. Again cost can be a factor in the choice of this component but lauric, myristic, palmitic, linoleic and behenic acids are all suitable. It is found that the acid tends to accumulate near to the surface of the composition as it is extruded.

Detailed description of the invention

Processing conditions depend on the formulations and the desired properties of the product to be produced. The materials need to be heated above 140 °C in the

extruder to fully gelatinise the starches. The die temperature needs to be controlled below 110 °C to avoid foaming.

The preferred method of carrying out this invention involves mixing the starch, modified starch, vinylalcohol polymer lubricant and fatty acid components into a free flowing powder. The premixing can be carried out in any conventional mixer. The powder is then introduced into a screw extruder and subjected to an elevated temperature by the shearing action of the screw and the application of external heat to the barrel. The temperature is raised to a maximum in the range of 130°C to 160 °C. Any liquid components including additional water are introduced during this initial phase. The melt that is formed is then propelled toward the die and in moving forward the temperature is reduced to a value in the range of 85 °C to 105°C.

A typical extrusion for rigid products has the following parameters:

Temperature profile °C : 60, 70, 90, 110,130, 145, 130, 120, 110

Screw Speed 120 rpm

Die Pressure 1400 psi

Flexible film can be formed by simply extruding from a sheet forming die and then increasing the speed of the take-off roller to achieve the reduced thickness needed for flexible film. Cooling of the film between the die and the roller is usually needed to ensure that the film does not adhere to the roller. De-humidified air to cool the film also assists in removing excess moisture from the film surface. If the film is formed by the blown tube method dehumidified air is used to blow the film as it exits the die. Talc may also be entrained in the air stream to reduce blocking of the film.

Examples 1-14

Biscuit trays were made by extruding a sheet and subsequently thermo forming the tray in a hot press. A twin screw extruder was used with a screw speed of 130rpm. The barrel temperature profile was 95 [die], 95 [adapter], 95, 95, 95, 95, 100, 130, 140, 150, 140, 110, 90, 60. The process avoided foaming at the die and did not require venting of the barrel to remove moisture.

The formulations and the initial observations of the trays' performance are given in the table 1.

More detailed tests were carried out on sheets made from examples 9 to 14 and these results are shown in tables 2, 3 & 4.

TABLE 1

Example	A939 [hydroxy propylated amylose]	Wheat Starch	PVOH	Glycerol	Stearic Acid	Remarks
1	37.46	37.46	8.1	14.29	0.84	Includes 4.02% talc no foam, fairly flexible, very strong
2	33.51	33.51	7.46	21.05	0.75	Includes 3.72% $CaCO_3$ No foam, flexible, weak
3	34.42	34.42	7.66	18.92	0.77	Includes 3.81% $CaCO_3$ slight foam, flexible, strong
4	35.38	35.38	7.88	16.67	0.79	Includes 3.92% $CaCO_3$ slight foam, flexible, strong
5	37.34	37.34	7.87	16.67	0.78	no foam, flexible, strong
6	38.41	38.41	8.08	14.29	0.81	no foam, flexible, strong
7	39.71	39.71	8.03	11.76	0.79	no foam, flexible, very strong
8	38.03	38.03	7.69	11.27	0.76	Includes 4.23% water no foam, flexible, fairly strong
9	81	0	8	10.2	0.8	
10	65	16	8	10.2	0.8	
11	57	24	8	10.2	0.8	
12	24	57	8	10.2	0.8	
13	16	65	8	10.2	0.8	
14	0	81	8	10.2	0.8	

Table 2 - Youngs Modulus

example	initial	24 hours	1 week
9	942.591	355.992	395.783
10	743.174	611.025	459.516
11	729.490	578.648	567.977
12	905.406	609.926	600.324
13	1079.915	519.888	688.400
14	1155.357	797.400	749.335

Table 3 – Stress at 0.2% yield offset

C	initial	24 hours	1 week
9	9.522	2.189	3.413
10	6.016	4.144	3.078
11	7.313	3.823	4.102
12	7.929	3.814	5.695
13	12.624	5.178	6.263
14	14.175	6.884	6.565

Table 4 - % strain at the breaking point

C	initial	24 hours	1 week
9	56.969	82,532	78.304
10	49.845	43.613	41.588
11	56.550	56.166	37.591
12	19.188	47.033	21.798
13	17.699	40.952	21.165
14	8,552	27.661	16.145

From the above tests and examples and based on cost considerations a suitable formulation for this biscuit tray application is:

A939 [hydroxy propylated amylose]	Wheat Starch	PVOH	Glycerol	Stearic Acid
15	65.2	8	11	0.8

The trays are biodegradable and have strength and flexibility properties comparable to the non biodegradable materials currently used. The costs of production are also comparable.

Examples 15 - 22

The effect of stearic acid content on the composition was tested using a formulation of :

Wheat starch	36%
Modified Amylose A939	36%
Polyvinyl alcohol	8%
Glycerol	10%
Water	10%

The mixture was processed at a feed rate of 1.5 a screw speed of 100 rpm and the temperature profile was 70, 90, 100,130, 140, 140, 130, 115, 110, 110, 110[die]

Example	Stearic acid content [%]	Torque [%]	Mass [g/min]	Quality of Sheet [observation]
15	0.0	57	101	Rough surface
16	0.4	51	100	Nice sheet
17	0.8	44	106	Nice sheet
18	1.2	39	114	Nice sheet
19	2	38	106	Sheet with some holes
20	3	38	106	Sheet with holes
21	4	35	101	Sheet with a lot of holes
22	5	34	102	Sheet with a lot of holes

The results show that torque is decreased with increase in stearic acid content. Output mass peaks at a stearic acid content of 1.2 g. the preferred range of stearic acid is 0.4 to 1.5 %.

Examples 23-26

The following four formulations have also been found suitable for use in forming packaging trays for foodstuffs such as chocolates and biscuits.

Materials	Example 23	Example 24	Example 25	Example 26
A939	39.5	39.5	79	79
Wheat starch	39.5	39.5	0	0
PVOH	8	8	8	8
Stearic acid	1	1	1	1
Glycerol	6	3	6	3
Water	8	10	8	10

EXAMPLE 27

Formulations as shown in table 5 were prepared for the purpose of assessing their performance under low and high humidity conditions and to assess the performance of the plasticiser under these conditions.

Table 5

Materials	A939 %	PVOH %	Stearic acid %	Water %	Glycerol %
A	79.5	7.95	0.8	0	11.75
B	78.31	7.84	0.8	4.35	8.7
C	78.31	7.84	0.8	7.25	5.8
D	78.31	7.84	0.8	10.15	2.9
E	79.5	7.95	0.8	11.75	0

Table 6 shows the strength characteristics at 65% RH and table 7 shows the characteristics at 15% RH for these formulations.

Table 6 – 65%RH

Formulation	Modulus [Mpa]	Yield S. [Mpa]	Elongation %
A	547	3.2	118
B	774	7.1	78
C	1080	14	65
D	1556	18	40
E	1832	27	28

Table 7 – 15%RH

Formulation	Modulus [Mpa]	Yield S. [Mpa]	Elongation %
A	1750	27	20
B	1916	33	26
C	2035	33	23
D	2447	38	24
E	2696	41	23

Tables 6 and 7 show that under high or medium relative humidity Glycerol improves toughness as measured by elongation. Under low relative humidity the glycerol absorbs water from the starch in the polymer and this decreases toughness.

Example 28

Two formulations were prepared on being formula E of example 27 and the other being the same except that 50 % of the A939 was replaced by wheat starch. Both formulas were processed extruded as sheet and then thermoformed into biscuit trays. The trays were used in a product trial where biscuits were placed in the tray packaged and then stored for three months. The performance and appearance of the trays were acceptable and as good as conventional non – biodegradable trays. The significant advantage of the trays made by both formulations were that disposal was much simpler. Conventional trays are difficult for consumers to

compress and their volume cannot be significantly reduced but by simply running these trays under a tap they can be compressed by hand into a small disposable pellet.

From the above description and examples it can be seen that the present invention provides a biodegradable starch polymer that is comparable in price and performance characteristics to conventional non-biodegradable polymers. Consequently packaging of products such as biscuits and chocolates using a rigid thermoformed tray can be just as presentable and attractive with the added benefit of being environmentally friendly. Similarly packaging of products such as bread, in flexible packaging films, can also be attractive and biodegradable.

CLAIMS

1. A biodegradable polymer having the composition

a) from 8 to 80% by weight of a starch modified to include an hydroxyalkyl C_{2-6} group or modified by reaction with an anhydride of a di-carboxylic acid

b) from 0 to 87.9% of starch

c) from 4 to 11% by weight of a water soluble polymer selected from polyvinylacetate, polyvinyl alcohol and copolymers of ethylene and vinyl alcohol which have a melting point compatible with the molten state of the starch components

d) from 0 to 20% by weight of a polyol plasticiser

e) from 0.1 to 1.5 % by weight of a C_{12-22} fatty acid or salt and

f) from 0 to 12% by weight of added water.

2. A composition as claimed in claim 1 wherein component e) is stearic acid.

3. A composition as claimed in claim 1 or claim 2 wherein component c) is a polyvinyl alcohol component.

4. A composition as claimed claim 1 wherein the polyol plasticiser is glycerol.

5. A composition as claimed in claim 1 wherein the polymer is thermoformable into rigid packaging products and the polyol plasticiser content is less than 11%.

6. A composition as claimed claim 5 wherein the polyol plasticiser content is zero and added water is from 10 to 12 %.

7. A composition as claimed in claim 1 wherein the polymer contains 10 to 16% of plasticiser and is formed into a flexible film.

8. A composition as claimed claim 7 wherein the water content is zero.

9. A process for forming starch polymer products which includes the steps of

a) forming a mixture of starch, a modified starch, a water soluble polymer or copolymer containing vinyl alcohol units, up to 20 % of added water and/or a polyol plasticizer and 0.4 to 1.5 % by weight of a C_{12-22} fatty acid or salt and

b) working the mixture and forming a melt within the temperature range of 130°C to 160 °C

c) reducing the temperature and further working the mixture and then extruding the mixture or injecting the mixture into a mould at a temperature of 85 °C to 105 °C without the need to remove water.

10. A process for forming starch polymer products as claimed in claim 9 wherein the polymer is extruded into a sheet and subsequently thermoformed into a packaging tray.

INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU 99/01101

A. CLASSIFICATION OF SUBJECT MATTER

Int Cl[7]: C08L 3/06, 3/08; C08K 5/04, 5/09

According to International Patent Classification (IPC) or to both national classification and IPC

B. FIELDS SEARCHED

Minimum documentation searched (classification system followed by classification symbols)
C08L 3/02, 3/06, 3/08; C08K 5/04, 5/09

Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched
AU: IPC as above

Electronic data base consulted during the international search (name of data base and, where practicable, search terms used)
DERWENT: WPAT, JAPIO
TERMS USED: MODIFIED STARCH; FATTY ACID/SALT, STEARIC ACID; PLASTICISER, GLYCEROL,GLYCOL

C. DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
X	Derwent Abstract Accession No. 96-482357, Class A11, and JP 08-245836 (CHISSO CORP), 24 September 1996 . Abstract	1, 3-9
X	Derwent Abstract Accession No. 97-083587, Class A17, and JP 08-325447 (CHISSO CORP), 10 December 1996. Abstract	1, 3-9
X	US 5691403 A (SHITAOHZONO et al.), 25 November 1997. Col. 2, line 51 - col. 3, line 3; col. 4, line 26 - col. 5, line 19; col. 6, lines 17-19; claims	1, 3-9

[X] Further documents are listed in the continuation of Box C

[X] See patent family annex

* Special categories of cited documents:

"A" document defining the general state of the art which is not considered to be of particular relevance

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"&" document member of the same patent family

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INTERNATIONAL SEARCH REPORT

International application No.
PCT/AU 99/01101

C (Continuation). DOCUMENTS CONSIDERED TO BE RELEVANT

Category*	Citation of document, with indication, where appropriate, of the relevant passages	Relevant to claim No.
A	US 5322866 A (MAYER et al.), 21 June 1994. whole document	1-9
A	US 5444107 A (AJIOKA et al.), 22 August 1995. whole document	1-9
A	US 5449708 A (DAVID SHILTZ), 12 September 1995. Whole document	1-9

INTERNATIONAL SEARCH REPORT
Information on patent family members

International application No.
PCT/AU 99/01101

This Annex lists the known "A" publication level patent family members relating to the patent documents cited in the above-mentioned international search report. The Australian Patent Office is in no way liable for these particulars which are merely given for the purpose of information.

Patent Document Cited in Search Report		Patent Family Member			
US	5444107	EP	530987	JP	05-039381

END OF ANNEX